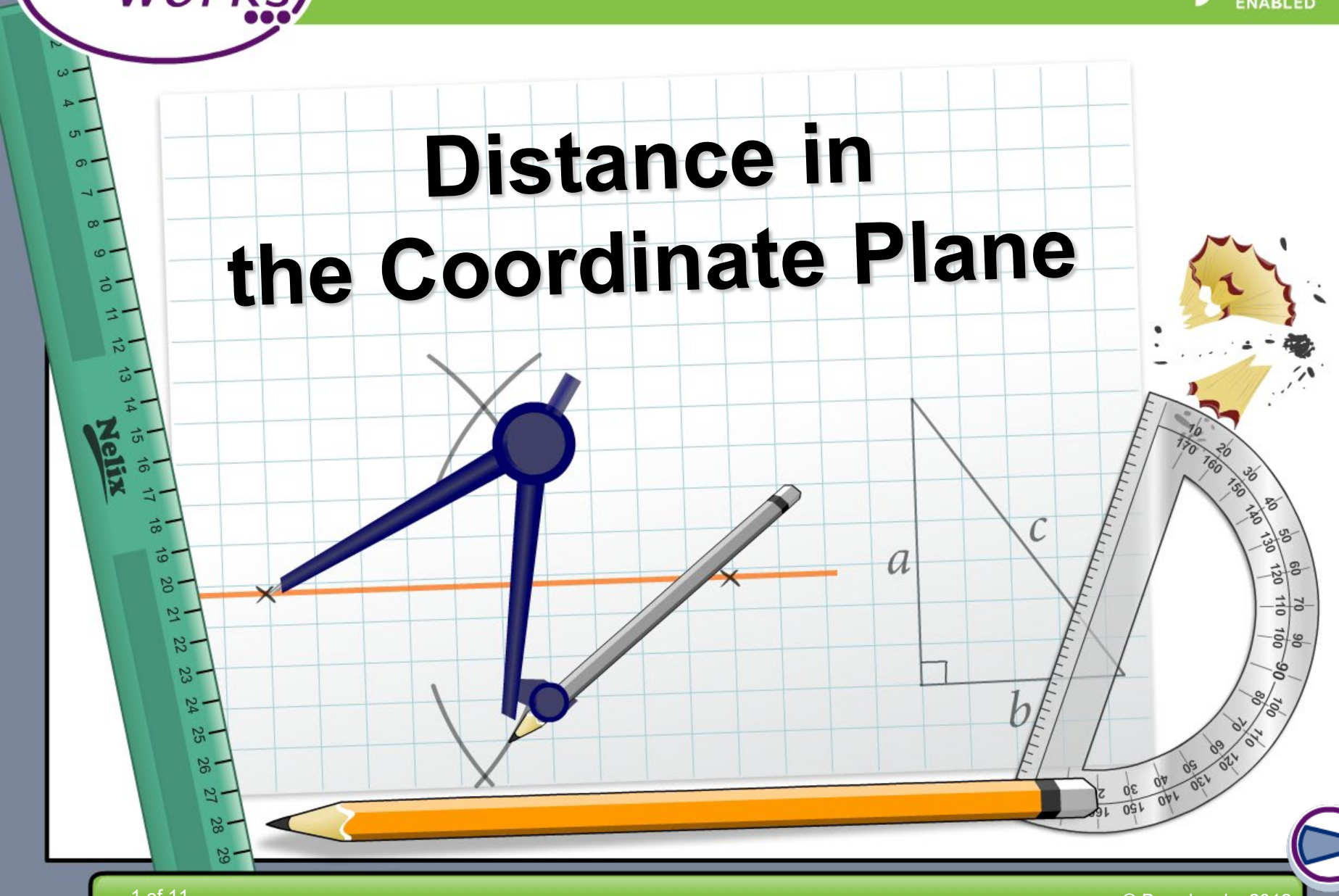
Distance in the Coordinate Plane



Information

Common core icons

This icon indicates a slide where the Standards for Mathematical Practice are being developed. Details of these are given in the Notes field.

Slides containing examples of mathematical modeling are marked with this stamp.

This icon indicates an opportunity for discussion or group work.

The **Standards for Mathematical Practice** outlined in the Common Core State Standards for Mathematics describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

These are:

1) Make sense of problems and persevere in solving them.

2) Reason abstractly and quantitatively.

3) Construct viable arguments and critique the reasoning of others.

4) Model with mathematics.

5) Use appropriate tools strategically.

6) Attend to precision.

7) Look for and make use of structure.

8) Look for and express regularity in repeated reasoning.

This icon indicates that the slide contains activities created in Flash. These activities are not editable.

This icon indicates teacher's notes in the Notes field.

The Cartesian coordinate system

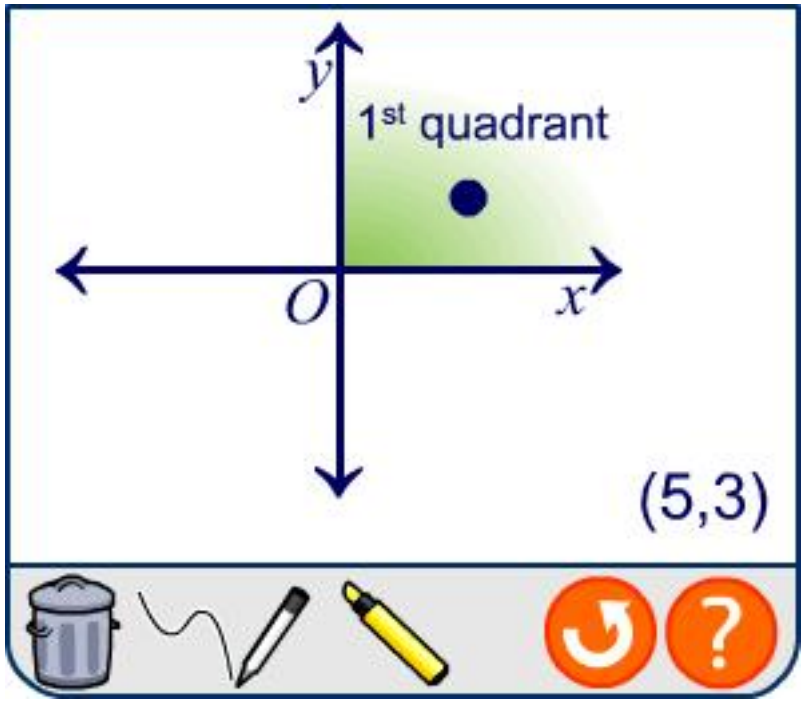
The Cartesian coordinate system is named after the French mathematician René Descartes (1596 – 1650).

Points in the **(x, y) plane** are defined by their perpendicular distance from the x- and y-axes relative to the origin, O.

The coordinates of a point P are written in the form $P(x, y)$.

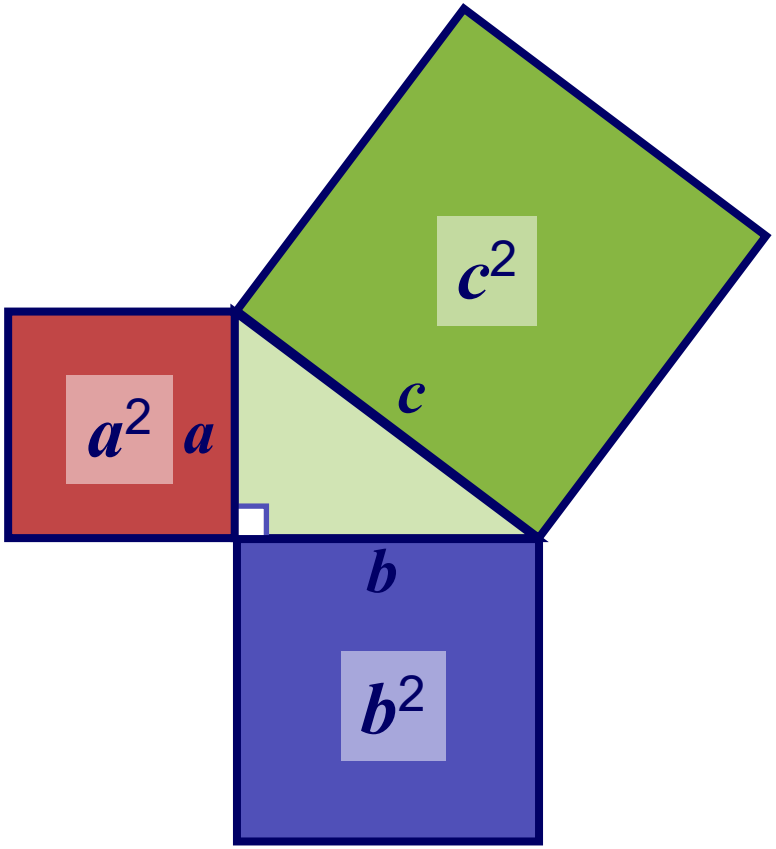
The x-coordinate gives the horizontal distance from the y-axis to the point.

The y-coordinate gives the vertical distance from the x-axis to the point.



Reviewing the Pythagorean theorem

The Pythagorean theorem:
In a right triangle, the square of the length of the hypotenuse is equal to the sum of the squares of the lengths of the legs.



The area of the largest square is $c \times c$ or c^2.

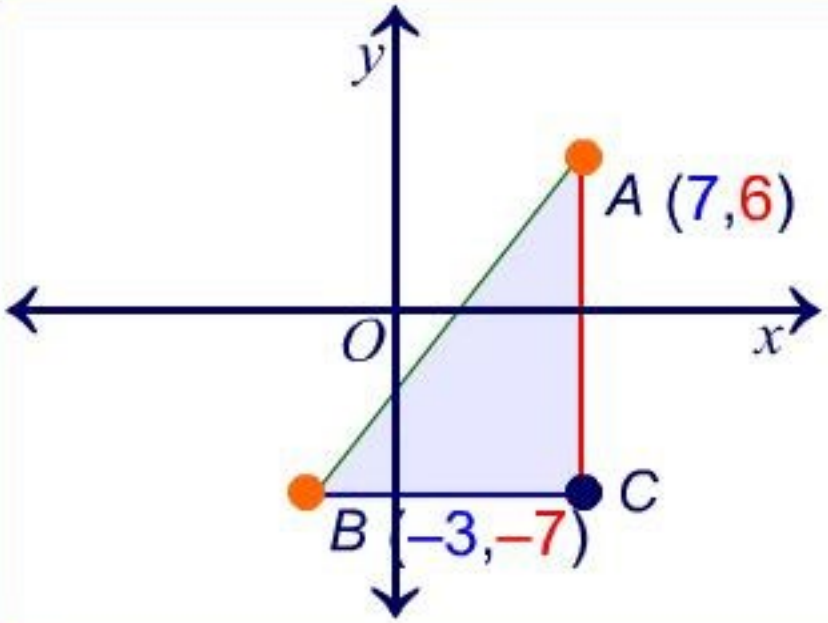
The areas of the smaller squares are a^2 and b^2.

The Pythagorean theorem can be written as:

$$c^2 = a^2 + b^2$$

The distance between two points

Given the coordinates of two points, A and B, the distance between them is found by the Pythagorean theorem.



$AC = 6 - -7 = 13$

$BC = 7 - -3 = 10$

using the Pythagorean theorem:

$AB^2 = 13^2 + 10^2$

The distance formula

What is the distance between two general points with coordinates $A(x_a, y_a)$ and $B(x_b, y_b)$?

horizontal distance between the points: $x_b - x_a$

vertical distance between the points: $y_b - y_a$

using the Pythagorean theorem, the square of the distance between the points $A(x_a, y_a)$ and $B(x_b, y_b)$ is: $(x_b - x_a)^2 + (y_b - y_a)^2$

taking the square root gives AB:

The distance formula: $AB = \sqrt{(x_a - x_b)^2 + (y_a - y_b)^2}$

Using the distance formula

The distance formula is used to find the distance between any two points on a coordinate grid.

Find the distance between the points $A(7,6)$ and $B(3,–2)$.

write the distance formula:

$$AB = \sqrt{(x_a - x_b)^2 + (y_a - y_b)^2}$$

substitute values:

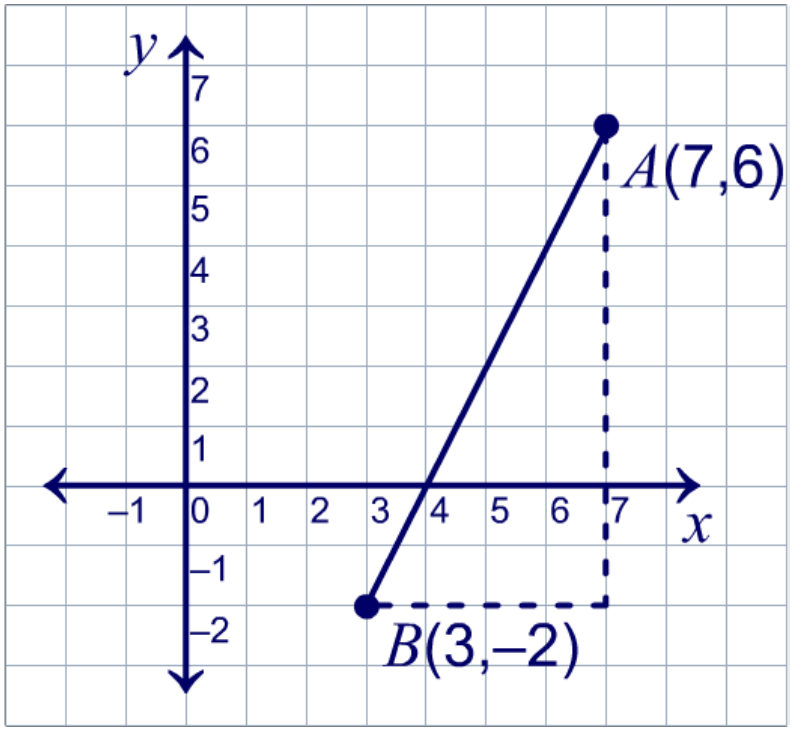
$$AB = \sqrt{(7–3)^2 + (6–(–2))^2}$$

$$= 4^2 + 8^2$$

$$= 16 + 64$$

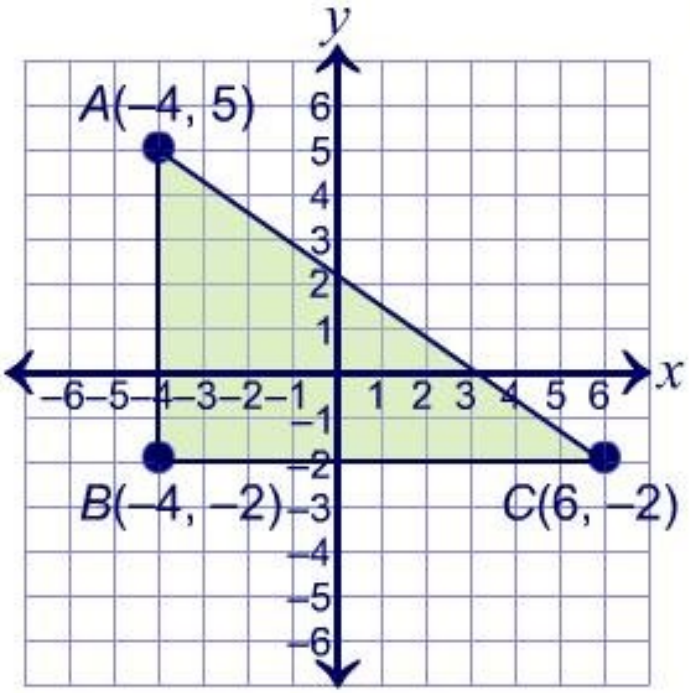
$$= \sqrt{80}$$

$$= \textbf{8.94 units (to the nearest hundredth)}$$



Find the lengths

Find the lengths using the distance formula



Question: 1/3

What is length AB?

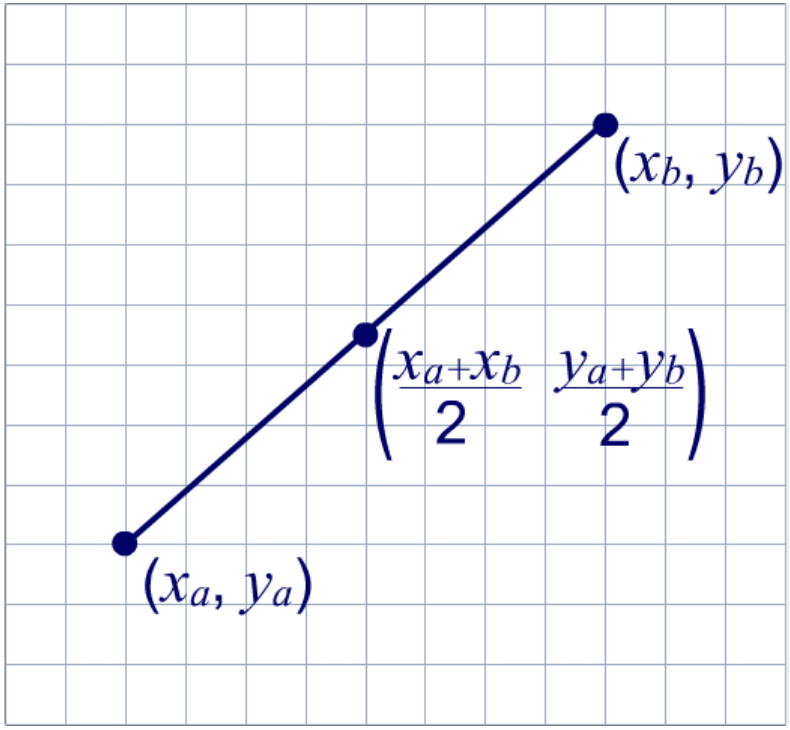
8 units	7 units
6 units	5 units

Press the "=" button to show the calculations step-by-step.

Finding the midpoint

The midpoint, M, of two points $A(x_a, y_a)$ and $B(x_b, y_b)$ is mean of each coordinate of the two points:

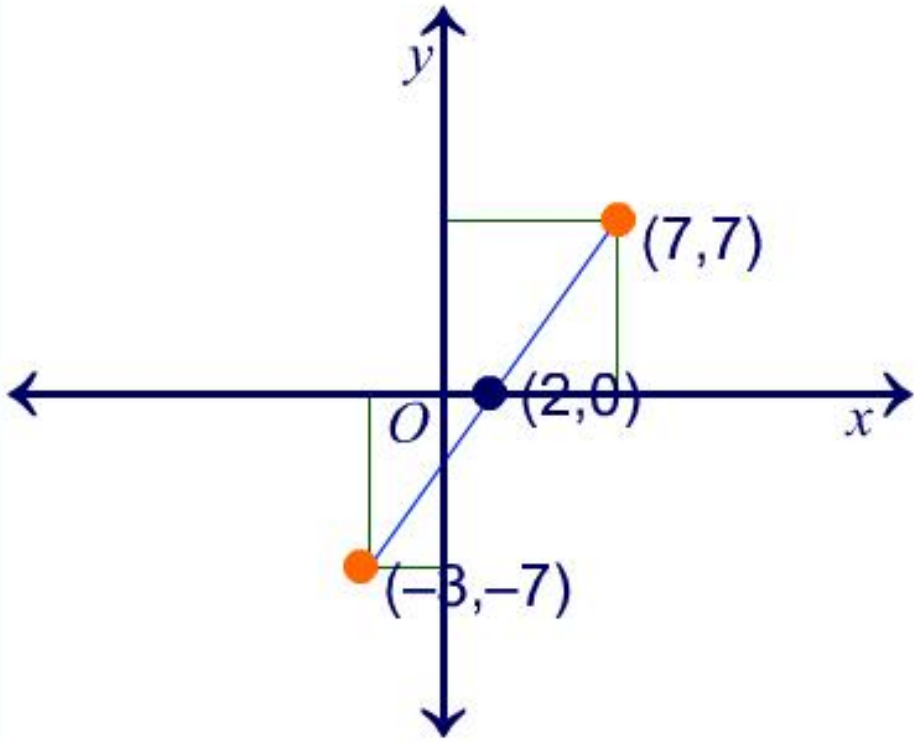
$$\left(\frac{x_a + x_b}{2}, \frac{y_a + y_b}{2}\right)$$



$\frac{x_a + x_b}{2}$ is the mean of the x-coordinates.

$\frac{y_a + y_b}{2}$ is the mean of the y-coordinates.

The midpoint of a line segment



The x-coordinate midpoint

$$\frac{7 + -3}{2} = 2$$

The y-coordinate midpoint

$$\frac{7 + -7}{2} = 0$$

Using midpoint

The midpoint of the line segment joining the point (–3, 4) to the point P is (1, –2). Find the coordinates of the point P.

Let the coordinates of the points P be (a, b).

midpoint formula: $\left(\frac{-3 + a}{2}, \frac{4 + b}{2}\right) = (1, -2)$

equating the x-coordinates:

$$\frac{-3 + a}{2} = 1$$

$$-3 + a = 2$$

$$a = 5$$

equating the y-coordinates:

$$\frac{4 + b}{2} = -2$$

$$4 + b = -4$$

$$b = -8$$

The coordinates of the point P are (5, –8).